TUNGSTEN POTENTIAL IN THE SAN JUAN AREA, OURAY, SAN JUAN, AND SAN MIGUEL COUNTIES, COLO.

BY CARL BELSER

* * * * * * * * * * Information Circular 7731

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by

Carl Belser 1/

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INTRODUCTION AND SUMMARY

This report on tungsten in Ouray, San Juan, and San Miguel Counties, Colo., is one of a series describing results of studies on the tungsten potentialities in Region III, Bureau of Mines. The San Juan tungsten deposits occur in an area of 250 square miles, centering near the common corner of Ouray, San Juan, and San Miguel Counties (fig. 1).

Field work supporting these studies was done in May 1954. Bureau of Mines reports prepared from investigations made during World War II and under the Defense Production Act of 1950 were reviewed.

In the early eighties a peculiar, brownish mineral was noted in the Adams lode on Bonita Mountain, San Juan County, and samples sent to Freiberg, Germany, were identified as hübnerite (Mn, Fe)WO_4. This mineral was later found in Dry Gulch on Cement Creek, San Juan County, in strong, quartz-lead veins (Ohio, Dawn of Day, Minnesota, Sunshine, and Galtie Boy mines).

Production of hübnerite began in or just before 1899. C. A. Cooper (4)[2/] wrote: "Several tungsten properties are now being worked." Ore containing 70 percent WO_3 had increased in price from $85 a ton to $350 a ton or $5 a unit in 1899. Cooper further stated that tungsten was known to occur in several of the developed mines and in a dozen or more prospects.

The first recorded production from the San Juan region was in 1900, when 11,000 pounds of concentrate containing 69.5 percent WO_3 was shipped. This ore was concentrated in the Fisher mill near the mouth of Dry Gulch. A small amount of tungsten was mined during 1901-8. In 1908 the Eveline tunnel was driven to cut the Dry Gulch tungsten veins at increased depth. The tungsten encountered reportedly was rather scattered, although of good grade. Tungsten mining remained dormant from 1908 until 1915, when an increase in price stimulated by World War I led to renewed activity. In 1916-17 Louis Shaffer operated a mill near the portal of the Yukon (Uncle Sam) tunnel, principally on ores from mines in Dry Gulch, and produced concentrates valued at $140,000. Hand-sorted ore from several mines also was shipped during this period. The Gold Hub Mining Co. constructed a mill at the portal of the Yukon (Uncle Sam) tunnel in 1936 to treat hübnerite ore from the Uncle Sam vein encountered in the tunnel, but the operation was reported to be unprofitable. Hand-sorted ore from various mines was shipped during World War II. In 1951 Williams and Welby installed machinery in the old Gold Hub mill and produced concentrates from the Dawn of Day-Ohio dump ores. The Silver Bell Mines Co. operated a small mill at Ophir, San Miguel County, in 1953.

2/ Underlined numbers in parentheses refer to items in the Bibliography at the end of this report.

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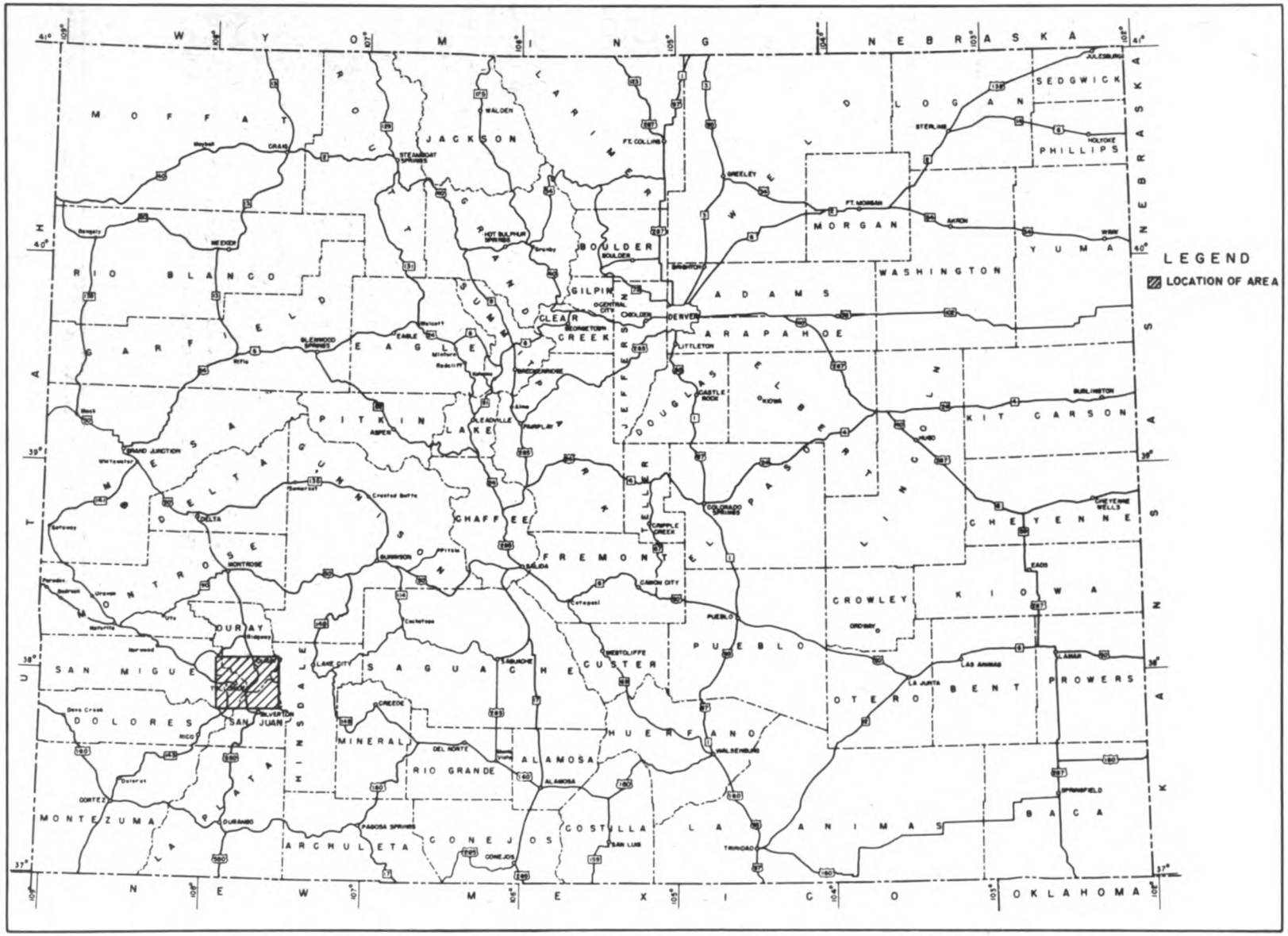

Figure 1. - Location of the San Juan tungsten area, Ouray, San Juan, and San Miguel Counties, Colo.

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The 1953 production for the area was 6,466 pounds (323 short-ton units) of tungsten trioxide, and the total production from 1900 through 1953 is estimated as 350,346 pounds (17,517 short-ton units) of tungsten trioxide. Indicated and inferred reserves are estimated as 72,000 tons containing 1.36 percent WO_3.

Production has been recorded from at least 24 mines, and the occurrence of tungsten has been reported at 17 other properties. During 1953, 5 properties mined tungsten ore and 2 mills were in operation. Of the 24 mines that have produced tungsten, 6 are in condition for immediate operation, 3 require improved ventilation, and 15 need considerable rehabilitation. Two mines which operated in 1954 received financial assistance from the Defense Minerals Exploration Administration.

PHYSICAL FEATURES

Near the center of the San Juan tungsten region, 3 mountainous ridges join at radiating angles of approximately 120°. These ridges form the boundary lines between Ouray, San Juan, and San Miguel Counties, and from the common point of intersection the drainage is north to the Uncompahgre River, west to the San Miguel River, and south to the Las Animas River (fig. 2). All three of these streams eventually flow into the Colorado River. To the southeast but outside the known tungsten region the drainage is to the Rio Grande. The region is extremely mountainous, containing narrow valleys and deep canyons. Altitudes range from a low of 7,721 feet at Ouray to over 14,000 feet.

Annual precipitation ranges from a low of 25 inches at Silverton to a high of 50 inches at Red Mountain. Snowfall is heavy and winters are severe, and with the exception of a few mines situated near the main highways access roads to small operations cannot be maintained in the winter.

The access roads, ranging from good to poor, extend to 12 of the 24 mines from which production has been made. Local material and equipment supply points are Silverton (population 1,375), Telluride (population 1,089), and Ouray (population 1,101). Denver and Rio Grande Western railroad facilities are available at Ridgeway from which good, all-weather highways extend 10 miles to Ouray, 34 miles to Silverton, and 40 miles to Telluride.

Native timber abounds in the region, but most mining timber is transported from other regions. Service lines of the Western Colorado Power Co. traverse the region.

Adequate labor and housing are available in Ouray, Silverton, and Telluride. Prevailing wages range from $1.50 to $2.00 an hour.

GENERAL GEOLOGY

The basement rocks of the area are Archaen schists and gneisses covered by about 8,000 feet of steeply tilted Algonkian quartzites and slates, which in turn are covered by about 3,600 feet of flat-bedded sedimentary formations of Cambrian, Devonian, and Carboniferous age. The sedimentary rocks are capped with approximately 6,200 feet of flat-dipping volcanic flows and tuffs of Tertiary age. The Silverton volcanic series, approximately 4,500 feet thick, is in the center of the Tertiary flow rocks and contains the principal known ore deposits. The Silverton series consists mainly of rhyolite, latite, and andesite flows, tuffs, and breccias. Igneous stocks and dikes have intruded the flat-dipping volcanic series.

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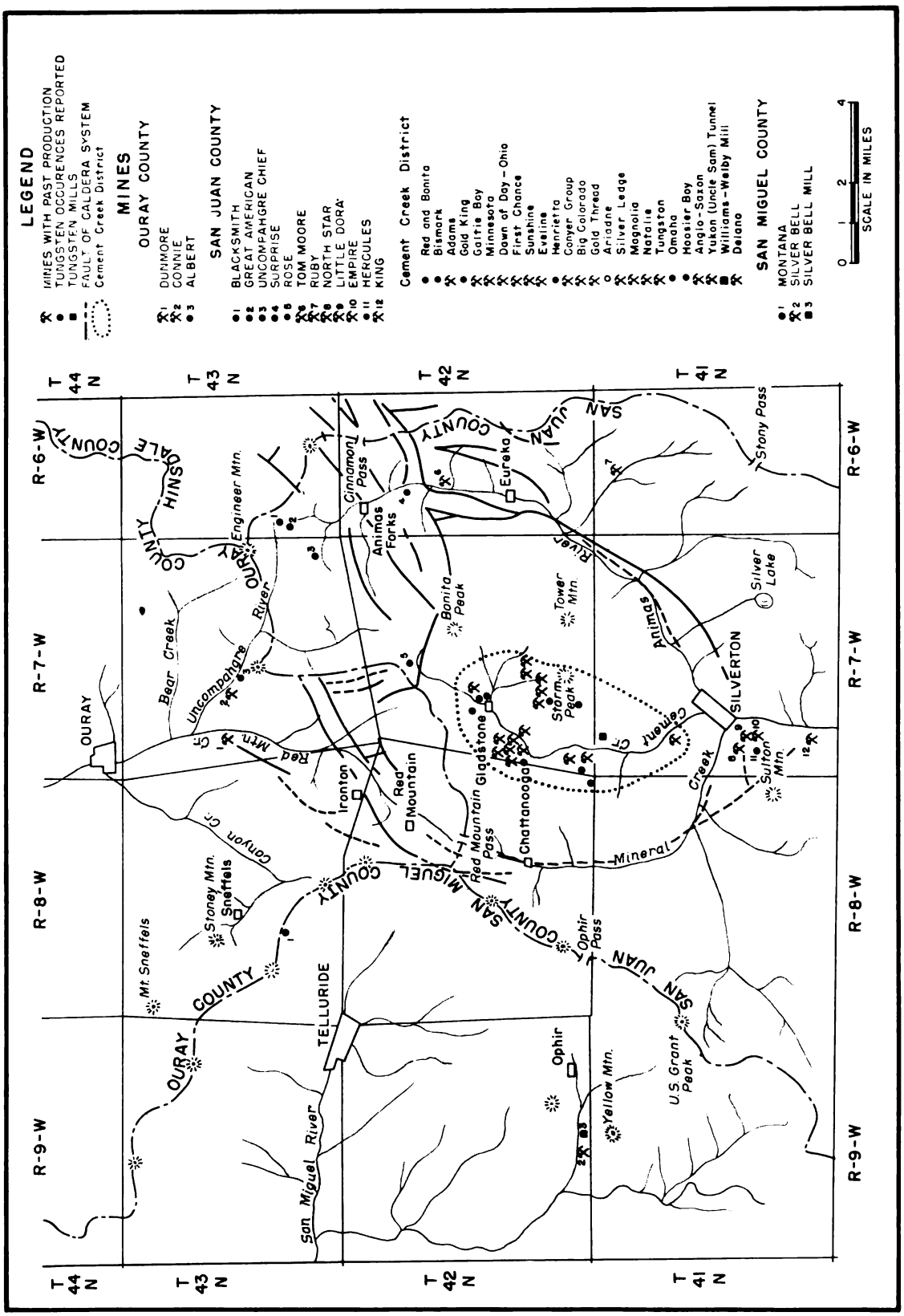

Figure 2. - Location of known and reported tungsten occurrences in Ouray, San Juan, and San Miguel Counties, Colo.

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A down-fault block, more or less circular and about 8 miles in diameter, is situated in the Silverton area. The east, south, and west sides of the block closely follow or parallel the Animas River and Mineral Creek (fig. 2). This fault block has a downward displacement of 1,500 to 2,000 feet and has been called the Silverton caldera (1, 2, 3, 7, 10). Stocks of monzonite and diorite have been intruded into a ring-fault zone. The known tungsten deposits are adjacent to or within the caldera or occur in or near igneous stocks or strong vein systems. The ore mineral hübnerite is often associated with fluorite. A small amount of scheelite occurs in some of the veins.

DESCRIPTION OF DEPOSITS

Tungsten has been mined from 24 properties and is known to occur in 17 others (fig. 2). The name, location (fig. 2), and ownership are as follows:

Mine	Location	Ownership
	Ouray County	
Dunmore	Sec. 17, T. 43 N., R. 7 W.	E. E. Eggleston.
Connie	Sec. 17, T. 43 N., R. 7 W.	Do.
Albert	Sec. 17, T. 43 N., R. 7 W.	Do.
	San Juan County	
Blacksmith	Sec. 30, T. 43 N., R. 6 W.	Merle Brush.
Great American	Sec. 30, T. 43 N., R. 6 W.	Do.
Uncompahgre Chief	Sec. 36, T. 43 N., R. 7 W.	London, Inc.
Surprise	Sec. 8, T. 42 N., R. 6 W.	Bently McMullen.
Tom Moore	Sec. 17, T. 42 N., R. 6 W.	Great Divide Mining & Milling Co.
Rose	Sec. 10, T. 42 N., R. 7 W.	Laurette Giroux.
Ruby	Sec. 5, T. 41 N., R. 6 W.	Angelo Dahla.
North Star	Sec. 19, T. 41 N., R. 7 W.	Mystery Gold Mining Co.
Little Dora	Sec. 17, T. 41 N., R. 7 W.	Do.
Empire	Sec. 19, T. 41 N., R. 7 W.	Do.
Hercules	Sec. 19, T. 41 N., R. 7 W.	Do.
King	Sec. 28, T. 41 N., R. 7 W.	San Juan County.
	San Juan County - Cement Creek district	
Red and Bonita	Sec. 16, T. 42 N., R. 7 W.	Atlas Mining Co.
Bismark	Sec. 16, T. 42 N., R. 7 W.	C. Maguire.
Adams	Sec. 16, T. 42 N., R. 7 W.	T. A. and D. A. Mahoney.
Gold King	Sec. 15, T. 42 N., R. 7 W.	San Juan Gold Mining Co.
Galtie Boy	Sec. 17, T. 42 N., R. 7 W.	F. L. Ross and E. M. Bacon.
Minnesota	Sec. 20, T. 42 N., R. 7 W.	Do.
Dawn of Day - Ohio	Sec. 20, T. 42 N., R. 7 W.	Victor Steele.
First Chance	Sec. 20, T. 42 N., R. 7 W.	Thomas Burgess.
Sunshine	Sec. 20, T. 42 N., R. 7 W.	Charles Bacon.
Eveline	Sec. 20, T. 42 N., R. 7 W.	Eveline M. and M. Co.
Henrietta	Sec. 19, T. 42 N., R. 7 W.	Blue Bird Mining Co.
Conyer group	Sec. 29, T. 42 N., R. 7 W.	Albert Conyers Est.
Big Colorado	Sec. 28, T. 42 N., R. 7 W.	F. B. Brown.
Gold Thread	Sec. 28, T. 42 N., R. 7 W.	Whised Lanning.
Ariadne	Sec. 28/35, T. 42 N., R. 7 W.	Ariadne Corp.
Silver Ledge	Sec. 27, T. 42 N., R. 7 W.	Victor Steele.
Magnolia	Sec. 27, T. 42 N., R. 7 W.	Silver Bay Mines, Inc.
Natalie	Sec. 27, T. 42 N., R. 7 W.	Do.
Tungsten	Sec. 30, T. 42 N., R. 7 W.	John Bendino.
Omaha	Sec. 31, T. 42 N., R. 7 W.	Unknown (N. P.).

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Mine	Location	Ownership
San Juan County - Cement Creek district (Con.)		
Hoosier Boy.....	Sec. 25, T. 42 N., R. 8 W.	Great Divide Mining Co.
Anglo-Saxon	Sec. 31, T. 42 N., R. 7 W.	San Juan Gold King Co.
Yukon tunnel (Uncle Sam)	Sec. 32, T. 42 N., R. 7 W.	Ariadne Corp.
Delano	Sec. 7, T. 41 N., R. 7 W.	Unknown.
San Miguel County		
Montana	Sec. 28, T. 43 N., R. 8 W.	Idarado Mining Co.
Silver Bell	Sec. 33, T. 42 N., R. 9 W.	Silver Bell Mines Co.

Ouray County

A brief description of the mines and prospects in the region follows:

Dunmore Mine (7 and 8)

The Dunmore mine is on the west side of Red Mountain Creek and about 5 miles by road from Ouray. Surface facilities consist of 2 small buildings, 2 ore bins, and a 900-foot, unusable aerial tramway, which has a terminal on U. S. Highway 550. The mine is developed by 2 adits at altitudes of 9,090 and 9,264 feet. The vein, which is about 100 feet wide throughout its 800 feet of exposed length, strikes N. 75° W. and dips 80° SW. Near the north wall is a 1- to 3-foot quartz streak. The south half of the vein is mostly barren, siliceous material. In this area two chimneylike deposits occur, which were probably formed by a number of fissures, striking N. 10° W., and crossing the Dunmore vein. One chimney 8 to 12 feet wide and 40 to 50 feet long contains hübnerite, and the other about 30 by 40 feet across contains hematite and copper sulfides. The country rock consists of Uncompahgre quartzite and Algonkian shale. The mine was first worked for gold. Tungsten ore was mined by the Frantz Bros. in 1937, and production has continued intermittently since that time.

Connie Mine

The Connie mine (7) is on the Dunmore fault about 4,000 feet southeast of the Dunmore mine at an altitude of 9,726 feet and is reached by trail from U. S. Highway 550. The vein is 15 feet wide and has quartzite walls with a 5-foot central rib of barren quartz. The strike of the vein is N. 78° W. and the dip is 80° SW. Country rock on the north side of the vein is Uncompahgre quartzite and to the south, San Juan tuff. The vein is developed by three short adits. Several tons of hand-sorted hübnerite ore have been produced as a byproduct in the development of a small lead ore body.

Albert Mine

The Albert prospect (7) is in Uncompahgre Canyon about 6 miles from Ouray and is located on the Dunmore vein fault about 7,000 feet southeast of the Dunmore mine. This fault has been traced on the surface for 3 miles and at the Dunmore mine reaches 100 feet in width in the underlying Uncompahgre formation but narrows to a few feet in the San Juan formation. The vertical displacement occurring in pre-San Juan time is about 2,800 feet and in post-San Juan time about 80 feet, the south side block being downward. The general strike of the fault is N. 75° W., and the dip is 80° SW. East of Red Mountain Creek, on the south side of the fault, a narrow intrusion of traprock can be traced for 1,200 feet. The prospect, at an altitude of about 9,760 feet, is developed by a few shallow workings. The surface rock is

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San Juan tuff. The vein strike is N. 70° W. and the dip is 75° SW. Some hübnerite occurs in the vein, but no ore has been shipped.

San Juan County

Blacksmith Mine

The Blacksmith mine (7) is on the south side and near the head of the Uncompahgre River at an altitude of about 12,000 feet. The property is about 15 miles by road northeast of Silverton and is on the northeastward end of a strong vein system that has an average strike of N. 50° E. and can be followed to the southwest for over 7 miles. About 6,000 feet southwest on the Del Norte claim the vertical displacement along the latite-andesite vein contact is 40 feet, the downward side being southeast. The vein at the Blacksmith mine strikes N. 60° E. and carries base-metal ores and, in places, hübnerite. Country rock is pyroxene andesite. Only a limited amount of development work has been done.

Great American Mine

The Great American mine (7) is on the south side and near the head of the Uncompahgre River 15 miles by road from Silverton at an altitude of 12,200 feet. The mine is on the same vein and has the same end-claim line as the Blacksmith lode. The vein strikes N. 60° E. through pyroxene andesite and reportedly contains a small amount of hübnerite with considerable base-metal sulfides.

Uncompahgre Chief Mine

The Uncompahgre Chief mine (70 is on the north side of Burrows Creek, a tributary of the North Fork of the Animas River, about 14 miles by road from Silverton at an altitude of 12,017 feet. The vein, striking N. 30° E. through Burns latite, is probably an extension of the Blacksmith vein. The principal vein minerals are sphalerite, tetrahedrite, and galena, with a quartz gangue, although some hübnerite is scattered through the quartz. Mine workings consist of several small shafts and adits and a few shallow pits and trenches. The mine has yielded hübnerite specimens, but no tungsten ore has been shipped.

Surprise Mine

The Surprise mine is on a claim recently located on the west side of the Animas River 11 miles northeast of Silverton at an altitude of about 11,000 feet. The vein strikes northeastward, and the country rock is Burns latite. It contains hübnerite, but no tungsten has been produced from the property.

Tom Moore Mine

The old Tom Moore workings (8) are on the east side of the Animas River 10 miles northeast of Silverton by road at an altitude of 11,500 feet. The vein has been developed by 5 adits, the lowest of which (altitude 10,400 feet) is 1,500 feet long. The vein strikes N. 50° E. through Eureka rhyolite and is heavily mineralized with base-metal sulfides. A quartz band 4 to 12 inches in width on the footwall contains hübnerite. The hübnerite-bearing band has been left on the wall except near the breast where it was mined, sorted, and shipped. The large dump contains hübnerite crystals. The vein can be traced for over a mile. Across the river to the south hübnerite stringers can be seen in the cliff face.

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Rose Mine

The Rose mine is at the head of Cement Creek near the Cement Creek Monument 11 miles from Silverton by road and trail at an altitude of 12,200 feet. The vein strikes N. 40° E. through pyroxene andesite and may be part of the Blacksmith-Uncompahgre vein system. A few short mine workings are accessible. A small amount of hübnerite ore is reported to have been shipped from the property.

Ruby Mine

The Ruby mine (8) is on the west side of Maggie Gulch 9 miles by road from Silverton at an altitude of 11,000 feet. A vein strikes N. 5° W. through Eureka rhyolite and reportedly is traceable for 3 miles on the surface. A stock of quartz monzonite is situated to the west and would be cut by the vein about half a mile to the northwest. The mine is developed by a 270-foot adit. Approximately 14 tons of 10-percent ore was produced in 1942 from an ore shoot 3 feet wide and 15 feet long. The mine was operated during the summer of 1953, and a small amount of hübnerite ore was produced.

North Star Vein

The North Star vein (8) is near the northwest end of the Mystery Gold Mining Co. group of claims and was worked through the North Star tunnel. This tunnel is just south of Silverton at an altitude of 9,430 feet, but it is now inaccessible. The North Star vein strikes about N. 30° W. through a large stock of quartz-monzonite. Hübnerite occurs with sulfide ores, but no tungsten ore has been shipped.

Little Dora Mine

The Little Dora Vein (8) is one of a group owned by the Mystery Gold Mining Co., which is south of Silverton. It strikes N. 20° W. through a large quartz-monzonite stock. Hübnerite occurs throughout the ore. A substantial quantity of tungsten has been produced, including 1 shipment of 19 tons of 35-percent hübnerite ore. The tungsten ore in the Mystery group of veins is darker than that from the Dry Gulch region, and the tungsten mineral might be wolframite.

Empire Vein

The Empire vein (8) is in a group of 45 claims covering the Empire, Champion, and North Star groups on Sultan Mountain, south of Silverton. The property contains many veins and has been developed by several adits. The more important are:

Name	Altitude Feet
Pittsburgh	9,240
Empire	9,400
North Star	9,430 (caved)
Boston	9,600
Jennie Parker	9,670
Ricker	9,850

The group has been worked as a gold-silver-lead mine but has produced some tungsten. The veins are within a large stock of quartz-monzonite and strike 15° N. 35° W. Tungsten has been known to occur in veins of the Mystery Gold Mining Co. group of claims since early in 1900. Veins in this area generally carry complex sulfides

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and small quantities of hübnerite. The Empire vein, striking about N. 15° W., contains an 8-inch band of hübnerite ore about 50 feet long from which 3 carloads of 26-percent ore were shipped from 1939 to 1941.

Hercules Vein

The Hercules vein (8) is the southeastern extension of the Little Dora vein, which is on the northeast side of Sultan Mountain south of Silverton. The vein strikes N. 30° W. through a large quartz-monzonite stock and contains some hübnerite ore. No shipments have been made. The Hercules and Little Dora properties are part of the holdings of the Mystery Gold Mining Co.

King Mine

The King mine (8) is on the west side of the Animas River 2 miles south of Silverton at an altitude of 9,900 feet. The vein strikes N. 5° E. through pre-Cambrian schists and gneisses east of a small stock of intrusive porphyry. It appears to be the southwest continuation of the Mineral Creek fault. The mine was principally worked for gray copper ore, but some tungsten has been produced.

San Juan County - Cement Creek District

Red and Bonita Mine

The Red and Bonita mine is on the east side of the north fork of Cement Creek about 9 miles by road from Silverton at an altitude of 10,900 feet. The mine is about 2,000 feet southwest of the Adams lode and has been worked extensively as a gold mine; however, the workings are caved. The vein strikes northeast and is reported to contain scattered deposits of hübnerite; hübnerite float has been found on the surface. No tungsten has been produced.

Bismark Mine

The Bismark mine is on the south fork of Cement Creek 9 miles by road from Silverton at an altitude of about 11,400 feet. Mine workings are caved. The Bismark vein, which strikes abtout N. 55° W., is in pyroxene andesite of the Silverton volcanic series. A small amount of honey-colored hübnerite is reported to have been produced from the property.

Adams Mine

The Adams lode (8) is on the east side of Cement Creek about 9 miles by road from Silverton at an altitude of 11,300 feet. The last 1,500 feet to the mine is over a poor trail. Hübnerite was identified in the Adams lode in the early eighties and was first mined in 1899. A substantial quantity of tungsten was produced during World War I. The vein is 3 to 4 feet wide, strikes N. 10° E., dips 80° SE., and contains quartz with specks of galena, pyrite, fluorite, and hübnerite. The hübnerite is reported to have occurred in bands up to 18 inches wide. Country rock is pyroxene andesite. This property, which may be near the southwest extension of the Bonita fault, is developed by two short adits and a deep surface cut but has been idle for a long time. Mine dumps appear to contain a milling grade of tungsten.

The owners have applied to the Defense Minerals Exploration Administration for assistance in exploring the deposit.

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Gold King Mine

The portal of the Gold King tunnel (8) is at Gladstone on Cement Creek 8 miles by road from Silverton at an altitude of 10,600 feet. The tunnel and upper workings (altitude 12,150 feet) are inaccessible. The vein strikes northeast through pyroxene andesite. This mine has produced considerable gold. In 1908 hübnerite was found in sheaflike crystals up to 3 inches in length and partly incrusted with quartz and fluorite in vugs along th vein. No tungsten has been produced.

Galtie Boy Mine

The Galtie Boy mine (8) is in Dry Gulch on the west side of Cement Creek 8 miles from Silverton at an altitude of about 10,800 feet. Originally the mine was worked for gold, silver, copper, and lead, but later tungsten was produced. An adit driven about 200 feet below the old workings, which are inaccessible, exposed 2 ore shoots, one 2.4 feet wide and 10 feet long and the other 1.7 feet wide and 60 feet long. The vein strikes northwestward through rocks of the Silverton volcancic series.

Minnesota Mine

The Minnesota mine (8) is between the Dawn of Day-Ohio and Galtie Boy mines at an altitude of about 10,900 feet. A short access road is needed to connect this property with the Dawn of Day-Ohio road. The vein strikes N. 60° W. through country rock consisting of Tertiary flows of the Silverton volcanic series. The vein has been stoped to the surface from a short, caved adit. The tungsten ore mineral is hübnerite, which occurs with lead and zinc in a quartz vein. An appreciable quantity of tungsten has been produced, and some indicated ore remains. A Defense Minerals Exploration Administration project has been approved for exploration of the property.

Dawn of Day-Ohio Mine

The Dawn of Day-Ohio property (8) consists of two claims end to end on the same vein. The mine is in the Dry Gulch area on the west side of Cement Creek 8 miles from Silverton by road and at an altitude of 10,900 feet. The vein strikes N. 60° W., dips 80° NE., and cuts through rocks of the Silverton volcancic series. It is 2 to 4 feet wide and contains hübnerite and base-metal sulfides. The Dawn of Day-Ohio is reported to contain a tungsten ore shoot 8 inches wide and 120 feet long of 40-percent WO_3 content. The mine has been developed by three short adits, which are caved. Almost all of the upper dump and part of the stope fills have been milled recently. The mine, which was worked for tungsten early in 1900 and during both World Wars, has been one of the most productive in the area.

First Chance Mine

The First Chance mine is in the Dry Creek area on the west side of Cement Creek and about 8 miles from Silverton. The vein strikes northwest in country rock of the San Juan volcanic series. The First Chance property was located recently by Thomas Burgess, who produced a small amount of tungsten from the property in 1953.

Sunshine Mine

The Sunshine mine is in Dry Gulch on the west side of Cement Creek 8 miles from Silverton by road at an altitude of about 11,000 feet. A vein strikes northwestward through rocks of the Silverton volcanic series. The Sunshine claim is adjacent to

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the Ohio claim. Tungsten ore occurs in a narrow band, and a small amount of hübnerite ore has been produced.

Eveline Mine

The Eveline mine is in Dry Gulch on the west side of Cement Creek 8 miles by road from Silverton at an altitude of 11,000 feet. The vein strikes N. 70° W. through the San Juan volcanic series. Tungsten was discovered on the vein before 1900, when a small amount was sold. The Eveline tunnel was driven from the foot of Dry Gulch in 1908 to intersect the known tungsten deposits. The mineral found was rather scattered but of good concentrating grade.

Henrietta Mine

The Henrietta mine is at the head of Prospect Gulch 11 miles by road from Silverton at an altitude of about 11,700 feet. The mine, which is developed by a lower adit from Dry Gulch, has been worked chiefly as a gold mine. The vein strikes N. 25° E. through rock of the Silverton volcanic series. Hübnerite reportedly occurs in the vein in small quantities, but none has been produced.

Conyer Group

This group of three claims (8) is near the mouth of Dry Gulch on the east side of Cement Creek 7 miles from Silverton by road at an altitude of 10,500 feet. Cement Creek may follow along hidden faults in the Silverton caldera, and two of these faults may intersect just above Dry Gulch. Such an occurrence would help to explain the many tungsten-bearing veins in this vicinity. The Conyer vein is in the Silverton volcanic series of Tertiary age. The Conyer property was a producer early in 1900 and during World War I, when several tons of ore assaying 30 percent WO_3 was mined. The mine reportedly has reserves of tungsten ore.

Big Colorado Mine

Big Colorado mine is on the west side of the south fork of Cement Creek 10 miles by road from Silverton at an altitude of about 11,100 feet. A vein striking N. 20° E. through pyroxene andesite is developed by a short crosscut adit with side drifts. Originally, the mine was worked for gold; later hübnerite specimens were found, but the property has not produced any tungsten ore.

Gold Thread Mine

The Gold Thread mine is on the west side of the south fork of Cement Creek 10 miles by road from Silverton at an altitude of about 11,000 feet. It is adjacent to the Big Colorado mine. The Gold Thread vein, striking N. 20° E. through pyroxene andesite flows of Tertiary age, is 18 inches wide and contains a persistent hübnerite streak 1 to 3 inches wide. Small lenses of hübnerite were seen in the vein in the 300-foot tunnel. Hübnerite was observed scattered throughout the dump, and tungsten was reported to have been produced during World War I.

Ariadne Mine

The Ariadne mine is on the east side of the north fork of Cement Creek near the head of Cascade Creek at an altitude of about 11,500 feet. An old wagon road 2 miles long connects the property with the Cement Creek road 6 miles northwest of Silverton. The Ariadne vein is about 60 feet wide and strikes N. 30° E. through

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pyroxene andesite. The vein is developed by a short crosscut adit with drifts along the walls from which complex sulfide ores were mined. Hübnerite occurs in places, but it has never been mined.

Silver Ledge Vein

The Silver Ledge vein is reached through two adits, both caved. The lower Occidental adit reportedly cuts the Silver Ledge vein at 300 feet, the Magnolia vein at 900 feet, and the Natalie vein at about 5,000 feet from the portal. The portal of the lower Silver Ledge adit is at an altitude of 11,000 feet and is 10 miles from Silverton by road. The upper adit dump contains a number of hübnerite specimens. The vein, striking N. 4° W., is in pyroxene andesite. It reportedly has been explored by 2,000 feet of drift and contains a persistent, narrow, tungsten-bearing zone. The mine was operated during the nineties as a gold mine. Some hübnerite ore has been shipped from the property.

Magnolia Vein

The Magnolia vein was reached through the Occidental adit, which is on the east side of the south fork of Cement Creek 10 miles by road from Silverton at an altitude of about 11,000 feet. The vein has been developed by 2,500 feet of drifts, and reportedly, a persistent,narrow, tungsten-bearing zone occurs in the vein. A small quantity of tungsten has been produced. The adit is inaccessible.

Natalie Vein

The Natalie vein, which outcrops at an altitude of 12,000 feet, is reached through the Occidental adit. It strikes N. 40° W. in pyroxene andesite. Spots containing good hübnerite ore have been found on the surface, and the vein encountered in the workings below reportedly contains considerable hübnerite. A small amount of tungsten ore has been produced from the mine.

Tungsten Mine

The Tungsten mine is in Minnesota Gulch on the west side of Cement Creek 6 miles from Silverton by road at an altitude of 10,500 feet. The vein on the property strikes N. 10° W. through Tertiary rock of the Silverton volcanic series. A small amount of hübnerite ore has been shipped from the property.

Omaha Mine

The Omaha mine is on an unpatented claim up Ohio Creek, a tributary of Cement Creek from the west and is about 5 miles from Silverton by road and trail. Good specimens of hübnerite reportedly have been taken from the property, but no shipments have been made.

Hoosier Boy Mine

The Hoosier Boy mine is at the head of Fairview Gulch on the west side of Cement Creek 8 miles by trail and road from Silverton at an altitude of about 12,000 feet. The Hoosier Boy vein, striking N. 25° E. through rocks of the Silverton volcanic series, probably is related to the Henrietta vein system. Hübnerite is said to occur in the vein, but no shipments have been made. Mine workings are limited. According to F. L. Ross, all veins in this area contain some hübnerite.

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Anglo-Saxon Mine

The Anglo-Saxon mine (8) is in Porcupine Gulch on the west side of Cement Creek at an altitude of about 10,300 feet. It is 5 miles northwest of Silverton over a county road that parallels Cement Creek to within a short distance of the property. The vein strikes N. 60° E. through rocks of the Silverton volcanic series. Some ore was produced during World War I.

Yukon Tunnel (Uncle Sam)

The Yukon tunnel (8), which cuts the Uncle Sam vein, is a long crosscut adit on the east side of Cement Creek 4 miles from Silverton by road at an altitude of 10,000 feet. The Uncle Sam vein is strong and strikes N. 25° E. through Eureka rhyolite. It is probably the same vein as the Ariadne, which crops out 6,000 feet farther northeast. Base-metal sulfide mineralization is found near both walls. Tungsten occurs as hubnerite with some scheelite and is found with galena, sphalerite, and pyrite in a zone 6 to 18 inches wide and about 100 feet long. High-grade specimens of hübnerite ore were obtained from the ore shoot by the Gold Hub Mining Co., who built a mill in 1936 to concentrate the hübnerite ore. Large pieces of hübnerite float are said to have been found on the surface about 1,500 feet vertically above the Yukon tunnel workings. These workings are not accessible at the present time. A small amount of tungsten concentrate has been produced.

Delano Mine

The Delano mine (8) is on the west side of Cement Creek at an altitude of 9,800 feet and 2 miles by road from Silverton. The northerly striking vein, which is 6 feet wide and cuts through rocks of the Silverton volcanic series, was developed during 1910 and worked during World War I. Production came from several small ore shoots, the largest of which was about 30 feet long. Reportedly, 5 tons of 61-percent WO_3 concentrate was made at the Shaffer mill from one lot of ore. A hübnerite band, 2 to 6 inches wide is said to have been developed for 1,300 feet.

San Miguel County

Montana Vein

The old gold-lead-zinc workings on the Montana vein are at the head of Marshall Creek at an altitude of 12,500 feet. The vein has been worked extensively and is opened by the Revenue tunnel (altitude 10,650 feet), the Argentine tunnel (altitude 10,590 feet), and a new adit from Pandora (altitude 9,100 feet). It is the northwestern part of Montana-Argentine-Black Bear vein system, one of the strongest in the San Juan region. The vein strikes N. 15° W. through rocks of the igneous Intermediate and San Juan series and through the underlying sedimentary rocks. This vein system can be traced directly to Stony Mountain, which consists of a gabro diorite stock 2 miles northwest of the Montana claim. The vein contains considerable base-metal sulfides, gold, and silver.

Originally the Montana vein was worked by A. E. Reynolds through the Revenue tunnel. Later the property was sold to the Tom Boy Gold Mining Co. and was worked extensively and then sold to the Telluride Mines Co., which now is part of the Idarado Mining Co. During World War II hübnerite ore from the north end of the Montana workings was hand-sorted and sacked but was not shipped. No known shipments of tungsten ore have been made.

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Silver Bell Mine

The Silver Bell group of claims at Ophir contains 2 tungsten-bearing veins, the Ida and Butler, which crop out at altitudes of 10,800 and 10,700 feet, respectively, and are cut by the Mill tunnel adit (elevation 9,550 feet). The Ida vein strikes N. 70° E. and the Butler vein N. 40° E., and they apparently junction or intersect to the southwest. Both veins dip steeply northwest in country rock composed of a large stock of diorite-monzonite. The mine is opened by 6 adits, and in places the veins have been drifted on for 2,000 feet. The veins are about 4 feet wide and contain base-metal sulfides. The footwalls of the veins are paralleled by narrower quartz veins containing wolframite and minor amounts of scheelite. Fifteen samples taken along the Ida vein averaged 1.69 percent WO_3 over a width of 2.5 feet.

This mine has been worked as a gold-silver-copper-lead-zinc property, and the major production was made before 1909. The property was active in 1922-23 and again from 1946 to the present time. Sixty tons of wolframite ore was shipped in 1940 from the Ida vein, and a small mill was erected in 1952 in which wolframite ores from the Ida and Butler veins were concentrated. The mine contains some reserves of hübnerite ore.

ORE RESERVES

Tungsten ore reserves have been estimated for 13 properties.

Ore reserve	Classification	Number of mines	Tons	Percent WO_3	Units WO_3
Ore in place	Inferred	11	50,550	1.6	84,525
Stope fills	do.	3	4,500	.6	2,900
Dumps	do.	7	16,950	.5	10,160
Total inferred ore		13	72,000	1.3	97,585

METALLURGY

Tungsten ores from the San Juan region have been hand-sorted or concentrated by gravity concentration. The remains of old jigs can be seen near the Adams, Dawn of Day-Ohio, and Delano mines. Three concentrating plants, now dismantled, were erected along Cement Creek for concentrating tungsten. Two plants (figs. 3 and 4) were operated during 1953. The tungsten ores are amenable to gravity concentration, but some of them contain considerable base-metal sulfides, which probably would require flotation concentration. Concentrates produced in mills have been of good grade, but all the mills have lacked fine crushing and grinding facilities, and it is doubtful if good recovery was obtained.

Tungsten samples from several mines were collected, and concentration tests were attempted in 1943 by the Bureau of Mines. The sulfide and tungsten ores were found amendable to concentration. After being ground and classified, the sulfides were recovered by flotation, from which the tails were tabled, the tungsten cleaned by magnetic separation, and the tailings and slimes scavenged by flotation. High recoveries were obtained.

At the Silver Bell mine the gold values of the ore are approximately proportional to the tungsten values. The ores of the Tom Moore, Silver Ledge, Natalie, Magnolia, Empire, Hercules, Little Dora, North Star, Ida, Butler, and Uncle Sam veins contain heavy base-metal sulfides. None of these veins, except the Ida and Butler, are being worked at the present time.

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WILLIAMS—WELBY MILL

(Powered by electricity)

ORE HAND SCREENED TO 1" AT MINE AND TRUCKED TO 70-TON MILL BIN. COARSE ORE HAND PICKED AND PUT THROUGH CRUSHER AT MINE.

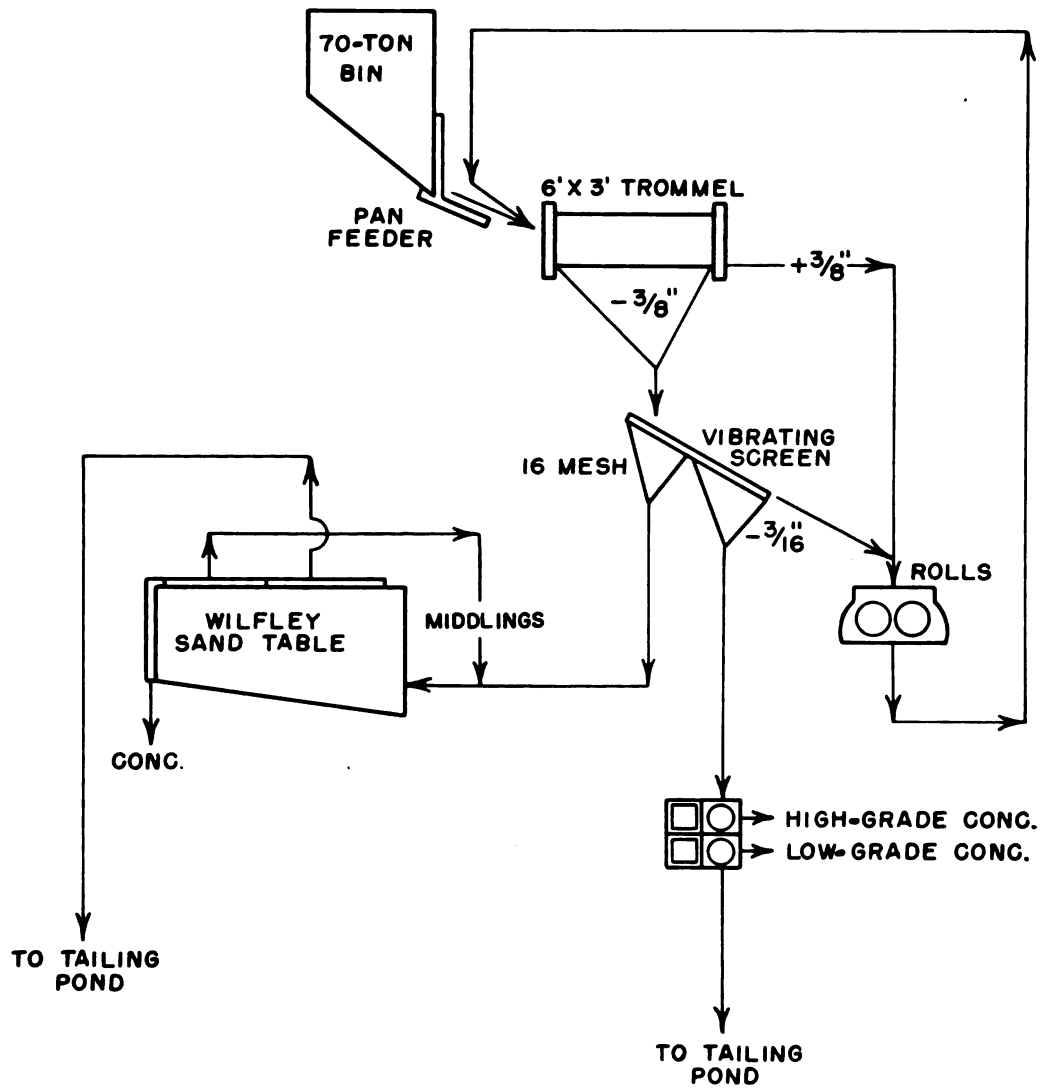

Figure 3. - Flowsheet of the Williams-Welby tungsten mill, San Juan County, Colo.

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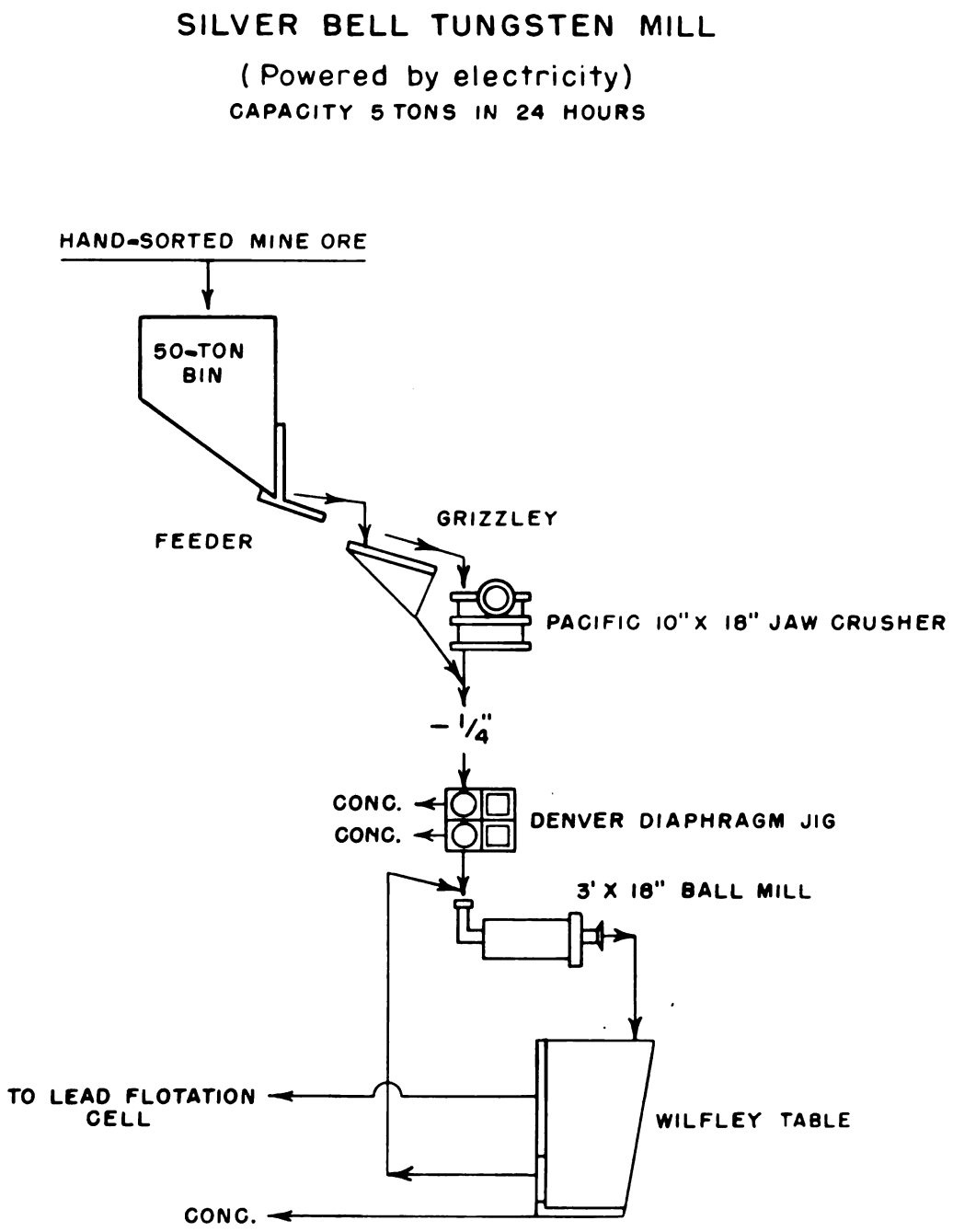

Figure 4. - Flowsheet of the Silver Bell tungsten mill, San Miguel County, Colo.

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The Silver Bell tungsten mill discontinued operations in 1953. Available information indicates that the Williams-Welby gravity plant will not be operated during 1955 by the old management.

CONCLUSIONS

Many tungsten mines and prospects in the San Juan region are potential producers. Future production will not be large, but some of the mines could yield a steady, significant output. The tungsten-bearing zones in most of the mines are narrow but can be traced up to several hundred feet in length. The known tungsten workings are small, and individual mine production will probably be on a small scale.

Several veins along Cement Creek contain hübnerite ore that is comparatively free of sulfide of lead and zinc and can be concentrated by simple gravity methods. However, most of the tungsten in the region occurs with sulfide ores, and many mines with both types of ore cannot be exploited for either tungsten or lead and zinc. These mines might be operated profitably if both tungsten and base-metal sulfide concentrates could be recovered.

Several mills in the region are idle but are equipped to process sulfide ores. If one of these mills were modified to include a tungsten unit, incentive to produce would be stimulated considerably.

Future custom-mill operations in the San Juan region should consider including tungsten concentrating facilities.

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